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Oxidation of spark plasma sintered ZrC-Mo and ZrC-TiC composites

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ABSTRACT

Two ZrC-based composites, ZrC-20 wt.% Mo cermet and ZrC-20 wt.% TiC solid solution mixed carbide, were prepared by spark plasma sintering. A sample of pure ZrC was also included in the test to be a benchmark reference. The oxidation performance of the composites was studied after exposing the samples to temperatures between 600 – 1200 °C in air. Thermogravimetric analysis were made to determine the weight change during oxidation, along with using XRD analysis to profile the chemical composition of the oxide layer at each temperature. Both pure ZrC and ZrC-Mo cermet suffer catastrophic oxidation at 1200 °C, either undergoing spalling or pesting, reducing the material to flakes or powder. ZrC-TiC, however, was able to resist severe oxidation damage up to 1200 °C. The oxide layer was determined to contain mixed oxide species $(Zr,Ti)O_2$ attributed to the mixed carbide, solid solution nature of the ZrC-TiC composite. This mixed oxide species was able to exert a more protective effect on the overall matrix beneath the oxide layer, stalling deeper oxidation into the microstructure.

Keywords: spark plasma sintering; oxidation; ceramic composites; ZrC-Mo; ZrC-TiC